Space Weather Technical Forecast

Issued on Friday, 01 March 2024 at 12:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Risk of M or X-Class flares from AR3590 in the northwest, declining through the period.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Activity has been Low during the last 24 hours, with just low level C-class flares. There are now nine sunspot regions on the disc. AR3590 remains the largest and most significant potential flare source, with a large delta spot within its intermediate portion remaining visible despite the increasingly foreshortened view. It also has a large amount of associated magnetic flux, increasing the potential for larger flares. AR3595 has a very weak and faint beta-gamma magnetic structure. AR3598 has continued to develop, with the penumbra around the lead and trailing spots consolidating. A new region on the southeast limb is likely to be the leading edge of ex-3576, which was active on the previous rotation, and may reveal more spots as it rotates further onto the disc. Remaining regions are smaller and simpler at the present time, with some decay.
No Earth directed CMEs were seen in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as recorded by ACE at L1 were at mostly ambient levels, although with some Unsettled geomagnetic activity which could have been caused by a solar sector boundary crossing, or a weak transient. Wind speeds generally varied between 350-410 km/s. Density was below average throughout. The interplanetary magnetic field, Bt, was weak throughout, below 6nT. The north-south component, Bz, varied weakly between +/-5nT, but was mostly southward directed. Phi angle was negative (towards the Sun), but switched to positive between 29/2300-01/0730 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background levels with the associated 24 hour fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 01/0000UTC was 1.56e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low to Moderate activity is expected with isolated M-class flares likely. There remains a slight chance of X-class flares from AR3590, although through Days 3 and 4 (03 and 04 Mar) this risk diminishes as AR3590 rotates behind the west limb.

Solar Wind / Geomagnetic Activity: There are three recent CMEs which are all most likely to miss Earth, but with a risk of some glancing influence later on Day 2 (02 Mar), perhaps extending into Day 3 (03 Mar). Otherwise no notable solar wind enhancements are expected. Geomagnetic activity is therefore forecast to be mostly Quiet (Kp 0-2), perhaps increasing to give Unsettled to Active (Kp 3-4) intervals with any CME influence on Days 2 and 3, with a very slight chance of an isolated G1/Minor Geomagnetic storm interval (Kp 5).

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is likely to stay at

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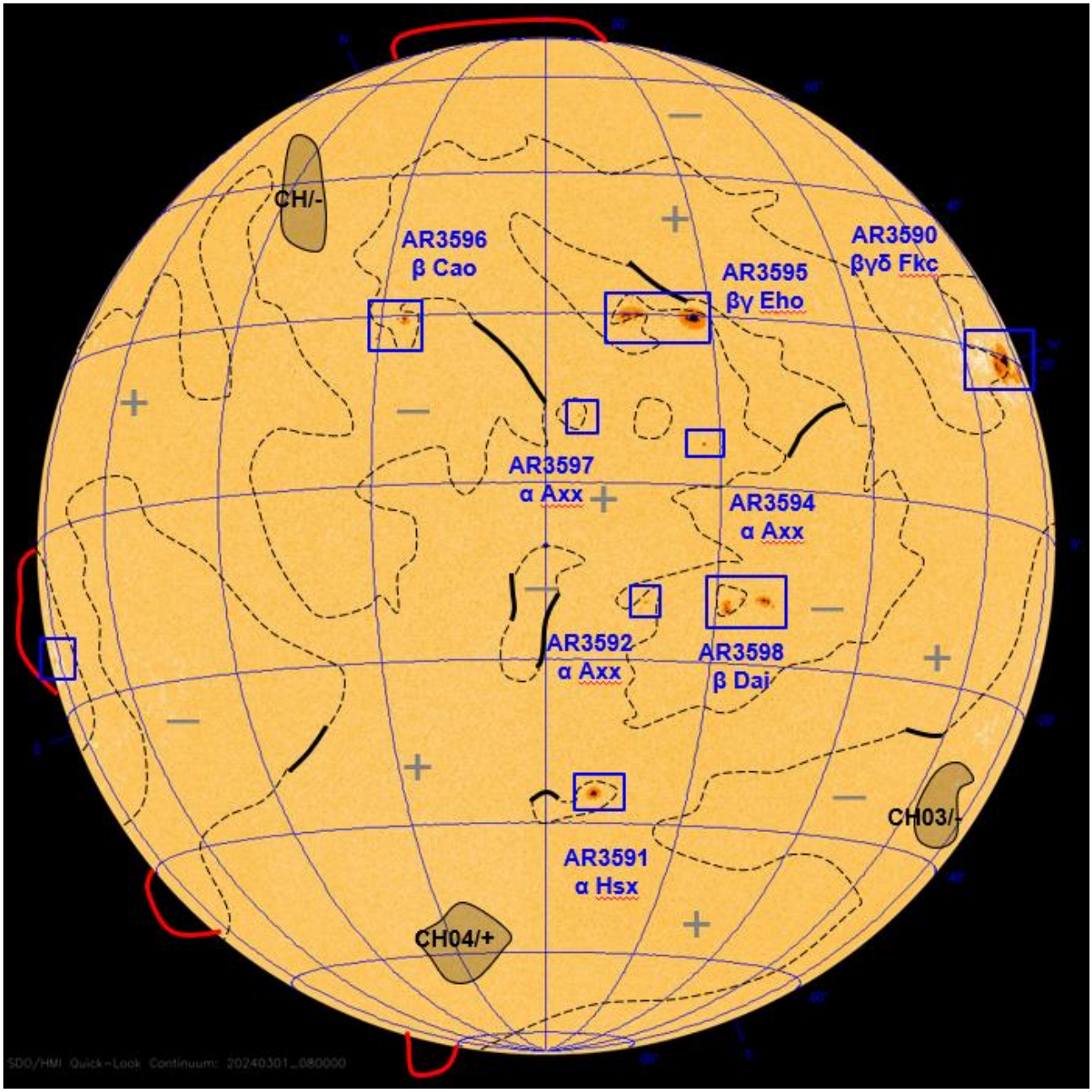
background levels, but with a slight chance of rising above S1 levels in response to any notable flares from AR3590, due to its position in the western disc. GOES16 high energy electron flux is expected to remain at background levels with the associated 24hr fluence remaining well below the Active threshold throughout.

Figure 1. Solar Analysis Valid 01/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

There are three recent CMEs which have been considered for any Earth directed influence - one from 27 Feb and two from 28 Feb. All are thought most likely to miss Earth, but with a risk of some glancing influence later on Day 2 (02 Mar), perhaps extending into Day 3 (03 Mar). Solar winds are expected to remain predominantly at background levels, in the absence of significant coronal hole influence or CMEs.

Geomagnetic activity is therefore forecast to be mostly Quiet (Kp 0-2), perhaps increasing to give Unsettled to Active (Kp 3-4) intervals with any CME influence on Days 2 and 3, with a very slight chance of an isolated G1/Minor Geomagnetic storm interval (Kp 5).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
27/1856	Partial	Filament	South centre	450 km/s	02/2100 UTC	Glancing blow possible
28/1335	Partial	Filament	Southeast	750 km/s	02/1200 UTC	Glancing blow possible
28/1743	Partial	Uncertain	Northeast	460 km/s	02/1800 UTC	Glancing blow possible

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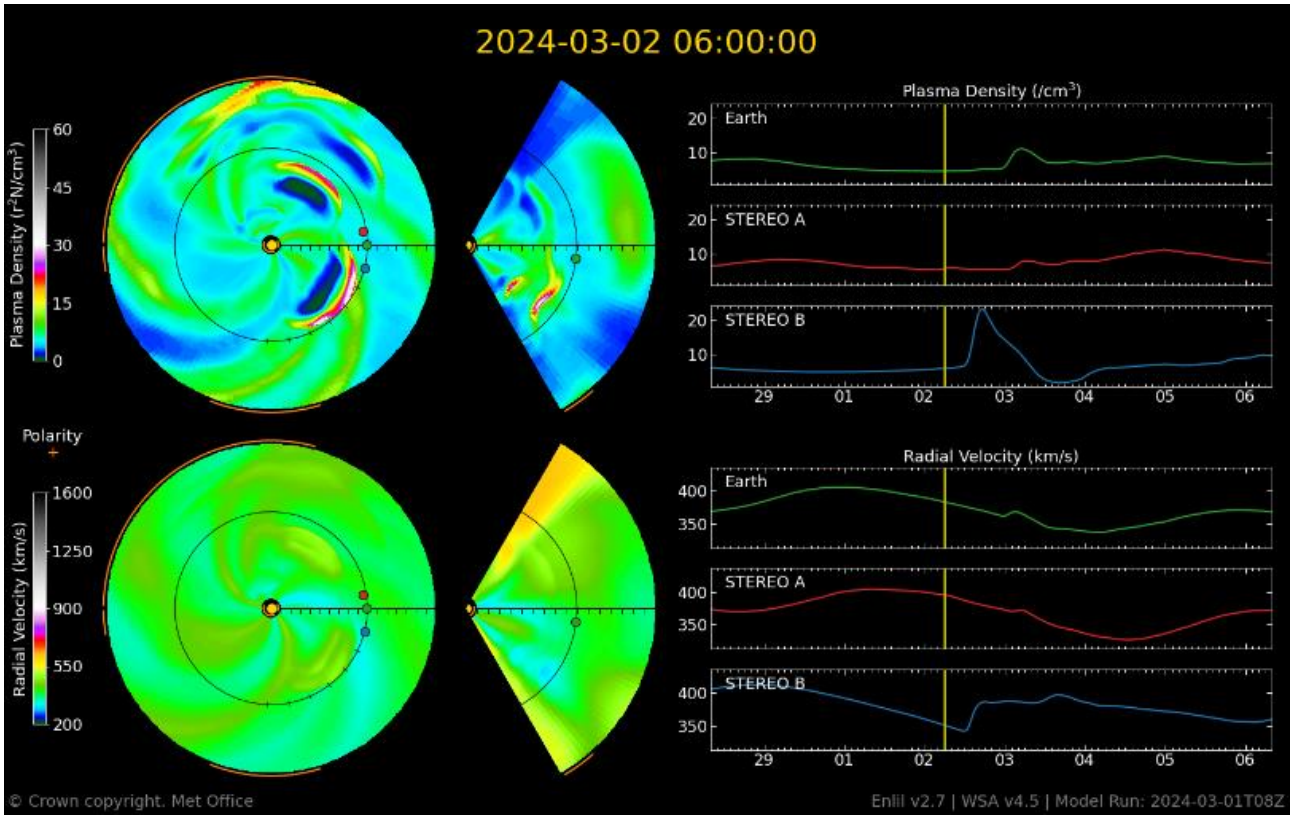
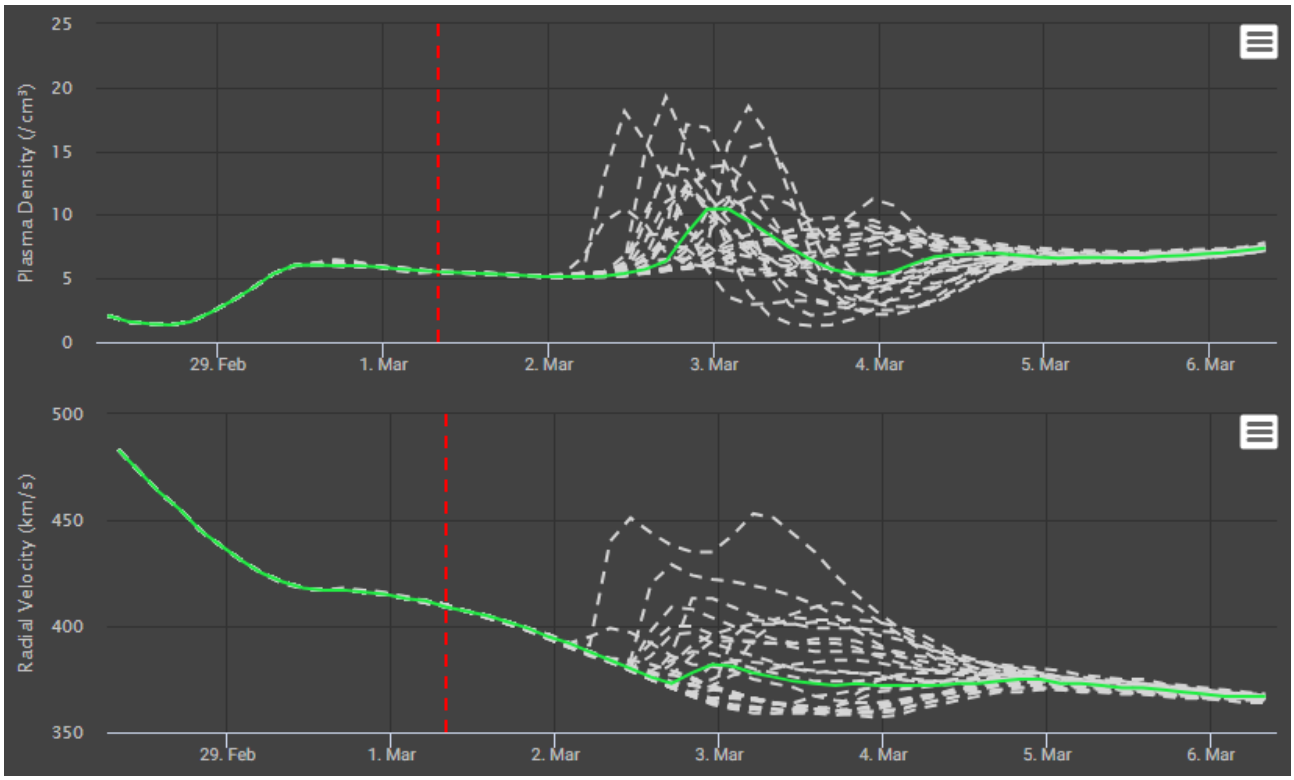
Figure 2: MOSWOC Enlil showing the possibility of glancing CME blows on 02 March into 03 March. Otherwise, it is suggesting largely background wind speeds.





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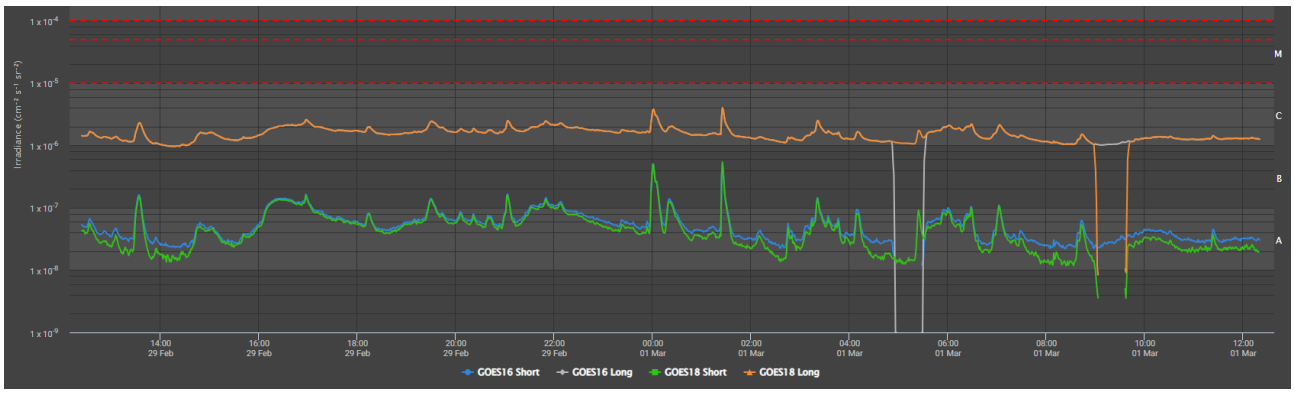
Radio Blackouts - X-Ray Flares:
Activity has been Low over the past 24 hours, with low level C-class activity.

There are now nine sunspot regions on the disc, with AR3592 weakly re-developing and a new region on the southeast limb. AR3590 remains the largest and most significant potential flare source, with a large delta spot within its intermediate portion remaining visible despite the increasingly foreshortened view. It is likely this region's classification will be maintained as it rotates towards the limb and becomes difficult to see. AR3595 has a very weak and faint beta-gamma magnetic structure. AR3598 has also continued to develop, with the penumbra around the lead and trailing spots consolidating. The new region on the southeast limb is likely to be the leading edge of ex-3576, which was active on the previous rotation, and may reveal more spots as it rotates further onto the disc. Remaining regions are smaller and simpler at the present time, with some decay.

Isolated M-class flares are considered likely, with a slight chance of X-class flares. The strongest flares are most likely to be from AR3590, although this will rotate off the disc late on Day 2 (02 Mar), with the risk of flares then declining thereafter. However, we await a clearer view of ex-3576 to see if this region still poses a risk of producing larger flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	60	50	40
Very Active	R3 to R5 X Class	No	15	15	15	5

Figure 3: X-ray flux recorded at GOES16 and 18, showing low level C-class flares.



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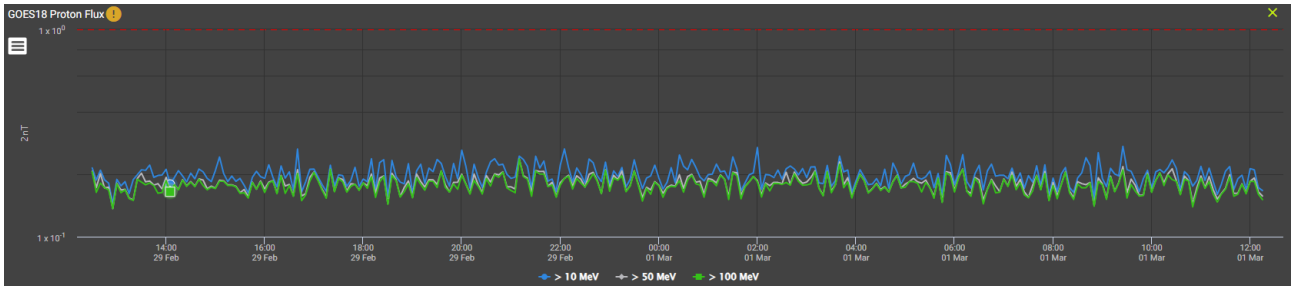
Solar Radiation Storms - (High Energy Protons):
GOES-18 proton flux is currently at background levels, and is likely to remain so through this period. However, there is a slight chance of enhancement as AR3590 is approaching the northwest limb. This is low confidence though, due to the current relatively low activity from the region. Although AR3590 rotates off the disc late on Day 2 (02 Mar), the risk of proton events remains until it is well over the west limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	10
Very Active	**≥ S3 ***	No	5	5	5	2

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Proton flux recorded at GOES18, showing background levels.



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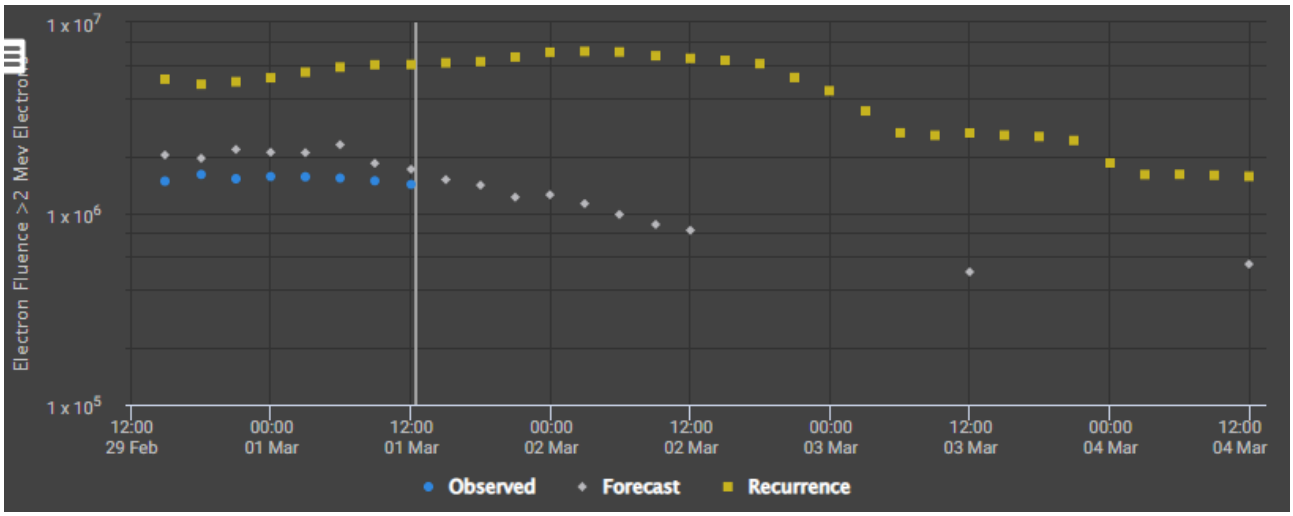
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at background levels. With the absence of significant coronal holes in the forecast, and only the potential for glancing CME influence, little change is expected.

The associated 24 hour fluence is expected to stay well below the Active (1e8 integrated pfu) threshold. MOSWOC REFM is currently thought to be giving reasonable guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM, showing a below Active forecast through the next three days.



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